

FORM PTO-1390
(Rev 5-93)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER

ZAHFRI P437US

U.S. APPLICATION NO. (PCT/IB/308)

107089732

INTERNATIONAL APPLICATION NO.

PCT/EP00/11582

INTERNATIONAL FILING DATE

November 21, 2000

PRIORITY DATE CLAIMED

November 25, 1999

TITLE OF INVENTION

PLANETARY GEAR FOR MOUNTING ON AN ELECTROMOTOR

APPLICANT(S) FOR DO/EO/US

Tino KIRSCHNER

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.
 2. ☐ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.
 3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
 4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
 5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
 - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☒ has been transmitted by the International Bureau. (PCT/IB/308 mailed 31 May 2001).
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
 6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)) is attached.
 7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
 - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☒ have not been made and will not be made.
 8. ☒ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
 9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
 10. ☒ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).
- Items 11. to 16. below concern other document(s) or information included:
11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98 with PTO FORM 1449.
 12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
 13. ☒ A FIRST preliminary amendment w/Marked-Up Version of Amended Specification.
 - ☐ A SECOND or SUBSEQUENT preliminary amendment.
 14. ☐ A substitute specification.
 15. ☐ A change of power of attorney and/or address letter.
 16. ☒ Other items or information:

<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Preliminary Examination Report <input checked="" type="checkbox"/> Annexes to Pre. Ex. Rep. <input checked="" type="checkbox"/> International Search Report <input checked="" type="checkbox"/> German Novelty Search Report <input checked="" type="checkbox"/> 12 copies of citations <input checked="" type="checkbox"/> Form PCT/IB/308 <input checked="" type="checkbox"/> International Publ. No. WO 01/38759 A1 (Face page only) 	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Copy of Request <input checked="" type="checkbox"/> Submission of Formal Drawings <input checked="" type="checkbox"/> 1 sheet of formal drawings <input checked="" type="checkbox"/> Abstract <input checked="" type="checkbox"/> German Language Specification
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CERTIFICATION UNDER 37 CFR 1.10

* I hereby certify that this Transmittal Letter and the papers indicated as being transmitted therewith is being deposited with the United States Postal Service on this date April 3, 2002 in an envelope as "Express Mail Post Office to Addressee" Mailing Label Number EL918840115 US addressed to the: Commissioner of Patents and Trademarks, Washington, D.C. 20231.

Anthony G. M. Davis
(typed or printed name of person mailing paper)

(signature of person mailing paper)

PATENT & TRADEMARK OFFICE



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17. ■ The following fees are submitted:

Basic National Fee (37 CFR 1.492(a)(1)-(5)):
 Search Report has been prepared by the EPO or JPO \$890.00
 International preliminary examination fee paid to USPTO (37 CFR 1.482) \$710.00
 No international preliminary examination fee paid to USPTO (37 CFR 1.482) but
 international search fee paid to USPTO (37 CFR 1.445(a)(2)). \$740.00
 Neither international preliminary examination fee (37 CFR 1.482) nor
 international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$1040.00
 International preliminary examination fee paid to USPTO (37 CFR 1.432)
 and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00
 ENTER APPROPRIATE BASIC FEE AMOUNT =

CALCULATIONS

PTO USE ONLY

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Surcharge of \$130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months
 from the earliest claimed priority date (37 CFR 1.492(e)).

0

Claims	Number Filed	Number Extra	Rate
Total Claims	11 - 20 =	0	x \$18.00
Independent Claims	1 - 3 =	0	x \$84.00

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Multiple dependent claim(s) (if applicable)	+ \$280.00
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TOTAL OF ABOVE CALCULATIONS =

0

Reduction by 1/2 for filing by small entity, if applicable. **Applicant claims Small Entity Status** (Note 37 CFR 1.9, 1.27, 1.28).

0

SUBTOTAL =

890

Processing fee of \$130.00 for furnishing the English translation later the ☐ 20 ☐ 30 months
 from the earliest claimed priority date (37 CFR 1.492(f)).

0

TOTAL NATIONAL FEE =

0

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be
 accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property

40

TOTAL FEES ENCLOSED =

930

Amount to be:
refunded \$

charged \$

- a. ■ A check in the amount of \$ 930.00 to cover the above fees is enclosed.
- b. ☐ Please charge my Deposit Account No. 04-0213 in the amount of \$ _____ to cover the above fees.
 A duplicate copy of this sheet is enclosed.
- c. ■ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to
 Deposit Account No. 04-0213. A duplicate copy of this sheet is enclosed.
- NOTE:** Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or
 (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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PRINTED & FORWARDED OFFICE



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04/3/02

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of : Tino KIRSCHNER
Serial no. :
Filed : with an effective filing date of November 21, 2000
For : PLANETARY GEAR FOR MOUNTING ON AN
ELECTROMOTOR
Docket : ZAHFRI P437US

The Commissioner of Patents and Trademarks
Washington, D.C. 20231

FIRST PRELIMINARY AMENDMENT

Dear Sir:

By way of preliminary amendment, please amend the above identified application as set forth below.

In the Specification:

Please cancel paragraphs 2, 3, 4, 8, 10, 15, 16, 17 and 18 of the specification, in their entirety, in favor of a clean form of paragraphs 2, 3, 4, 8, 15, 16, 17 and 18 of the specification, without any markings thereon, as follows. Accompanying this response is a copy of the original paragraphs of the specification which show the additions (by underlining and bold) and the deletions (by strikeout) to the canceled specification paragraphs. Please enter the replacement specification paragraphs into the record of this case.

In the Claims:

Please cancel claims 1-11, without prejudice or disclaimer of the subject matter therein, in favor of new claims 12-22 as follows.

[022] FIELD OF THE INVENTION

[003] The invention relates to a planetary gear for mounting on an electromotor.

[004] BACKGROUND OF THE INVENTION

[008] SUMMARY OF THE INVENTION

[015] BRIEF DESCRIPTION OF THE DRAWING

[016] The invention will now be described, by way of example, with reference to the accompanying drawings in which:

[017] Fig. 1 shows a longitudinal section through a planetary gear according to the invention.

[018] DETAILED DESCRIPTION OF THE INVENTION

12. (NEW) A planetary gear for mounting on an electromotor, having planetary gear wheels (10) fitted in a rotating planetary carrier (8) that forms an output and which are in simultaneous gear-tooth engagement with a sun gear (12) and an annular gear (14) positioned in a housing (2), such that the sun gear (12) is connected to a rotating sun gear shaft (4), which is hollow in a receiving area (16) to receive an output shaft of an electromotor, a sealing element (22) being provided between the sun gear shaft (4) and the housing (2), wherein the sealing element (22) is located axially outside the receiving area (16) for the output shaft of the electromotor, in an axial section of the sun gear shaft (4) with a reduced outer diameter compared to the receiving area (16).

13. (NEW) The planetary gear according to claim 12, wherein there is at least one bearing (28) for the sun gear shaft (4), whose inner ring is located axially outside the receiving area (16) for the output shaft of the electromotor on an axial section of the sun gear shaft (4) with a reduced outer diameter compared to the receiving area (16).

14. (NEW) The planetary gear according to claim 13, wherein the outer bearing ring of the bearing (28) for the sun gear shaft (4) is positioned in the planetary carrier (8).

15. (NEW) The planetary gear according to claim 13, wherein the bearing (28) for the sun gear shaft (4) is located radially inside an inner ring of a planetary carrier bearing (30) and axially at least partly within the space occupied by the planetary carrier bearing (30).

16. (NEW) The planetary gear according to claim 15, wherein the planetary carrier (8) has through bores (34, 36) on either side of each planetary gear wheel (10) to accommodate a planetary bearing pin (38) on which the planetary gear wheel (10) is mounted for rotation and an end face of the planetary bearing pin (38) abuts against inner bearing rings of planetary carrier bearings (30, 32), whereby the planetary bearing pin (38) is secured against axial displacement.

17. (NEW) The planetary gear according to claim 14, wherein an annular groove (48) is provided in the planetary carrier (8) to receive a circlip (46), which is axially adjacent to a functional surface (47) that receives the outer bearing ring of the bearing (28) for the sun gear shaft, and the outer bearing ring is secured against axial displacement in one direction by the circlip (46).

18. (NEW) The planetary gear according to claim 17, wherein the sun gear shaft (4) is mounted so that it can be axially displaced against the restoring force action of an elastic compensating element (56).

19. (NEW) The planetary gear according to claim 18, wherein the axial compensating element is positioned axially between a face of the outer bearing ring opposite the circlip (46) and a functional surface (54) of the planetary carrier (8).

20. (NEW) The planetary gear according to claim 19, wherein the elastic compensating element is an O-ring (56).

21. (NEW) The planetary gear according to claim 13, wherein the sun gear shaft (4) is fitted so that it cannot move axially relative to the housing (2) and a spring-disc coupling is arranged between the sun gear shaft (4) and the output shaft of the electromotor to compensate for axial displacements.

22. (NEW) The planetary gear according to claim 12, wherein the diameter of the functional surface (26) of the sun gear shaft (4) associated with the sealing element (22) is smaller than the diameter of the bore (18) in the receiving area (16) of the sun gear shaft (4).

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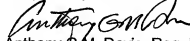
REMARKS

Accompanying this response, please find marked-up paragraphs of the specification which overcome some informalities noted in the specification. The undersigned avers that the enclosed replacement paragraphs of the specification do not contain any new matter.

Please consider new claims 12-22 upon consideration of this application.

In the event that there are any fee deficiencies or additional fees are payable, please charge the same or credit any overpayment to our Deposit Account (Account No. 04-0213).

Respectfully submitted,



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[001] PLANETARY GEAR FOR MOUNTING ON AN ELECTROMOTOR

[002] **FIELD OF THE INVENTION**

[003] The invention relates to a planetary gear for mounting on an electromotor; according to the pre-characterising portion of the principal claim.

[004] **BACKGROUND OF THE INVENTION**

[005] Such planetary gears are used for many purposes in automation technology and plant and machinery in general. With such a planetary gear, in which a sun gear can be driven by an output shaft of the electromotor, an annular gear is positioned in the housing and a planetary carrier forms the output, various transmission ratios, typically in the range 4:1 to 10:1, can be produced by varying the geometry of the sun gear and planetary gear wheels and of the planetary carrier.

[006] Owing to the high power density involved, even small internal power losses can give rise to undesired high temperatures. Because of the compactness of the structure, the heat generated by these losses often cannot be dissipated to the desired extent. High temperatures affect service life adversely. A large part of the power loss is attributable to the seals and bearings of the rapidly rotating sun gear shaft on the input side.

[007] A gear of this type is disclosed for example in DE 198 08 184 C1. To receive an output shaft of the electromotor, the sun gear shaft of this known planetary gear is made hollow in a receiving area of enlarged diameter. The sun gear shaft is sealed with respect to the housing by a radial sealing ring.

[008] **SUMMARY OF THE INVENTION**

[009] The purpose of the present invention is to develop further a planetary gear of the type described so as to minimise the power loss. Furthermore, the planetary gear should be of compact structure and economical to manufacture.

[010] — The invention's objectives are achieved by a planetary gear of the said type incorporating also the features of the characterising portion of the principal claim.

[011] Thus, in accordance with the invention the sealing element that seals the sun gear shaft on the outside with respect to the housing is arranged axially

{015} _____

{016} _____ Other advantageous features of the invention are explained

{015} BRIEF DESCRIPTION OF THE DRAWING

{016} The invention will now be described, by way of example, with reference to the attached drawing: **accompanying drawings in** which;

{017} Fig. 1 shows a longitudinal section through a planetary gear according to the invention.

{017}

{018} DETAILED DESCRIPTION OF THE INVENTION

{019} In the single figure attached, the housing is indexed as 2, the sun gear shaft on the input side as 4 and the output shaft of a planetary gear according to the invention as 6. The output shaft 6 rotates with a planetary carrier 8, on which several uniformly distributed planetary gear wheels 10 are mounted and able to rotate. The planetary gear wheels 10 are in simultaneous gear-tooth engagement with a central sun gear 12 that can be driven by the sun gear shaft 4 and with an annular gear 14 fixed in the housing 2.

{020} To receive an output shaft (not shown) of an electromotor, the sun gear shaft 4 has a hollow receiving area 16 that extends axially over the length of a cylindrical bore 18 in the sun gear shaft 4. The inside space of the housing 2 is filled with lubricant and sealed with respect to the outside by two sealing elements formed as radial sealing rings 20, 22. The radial sealing rings are fixed in the housing 2 and are associated with cylindrical functional surfaces 24, 26 of the output shaft and the sun gear shaft respectively. Sliding friction takes place between the radial sealing rings and the said functional surfaces.

{021} According to the invention, the radial sealing ring 22 arranged between the housing 2 and the sun gear shaft 4 is positioned outside the receiving area 16 for the output shaft of the electromotor in an axial section of the sun gear shaft whose outer diameter is smaller compared with that of the receiving area. Only very small frictional losses occur on the functional surface 26, whose diameter is smaller than the diameter of the bore 18, so that higher efficiency is attained and problems due

to high temperatures are avoided. Between the receiving area 16 and the location of the radial sealing ring 22 the sun gear shaft has a diameter step 23.

[022] The inner ring of the bearing 28 for the sun gear shaft 4 is also arranged outside the receiving area 16 for the output shaft of the electromotor in an area with reduced outer diameter, so that a bearing of smaller size can be used.

[023] The diameter of the bearing holder on the sun gear shaft is also smaller than the diameter of the bore 18.

[024] The outer bearing ring of the bearing 28 is located in the planetary carrier 8, radially inside the inner ring of a planetary carrier bearing 30. The bearing 28 is positioned axially within the structural space occupied by the planetary carrier bearing 30, and this makes it possible for the axial length of the planetary gear to be short. For the planetary carrier 8 a second bearing 32 is provided which, like the bearing 30, is in the form of a conical-roller bearing and which forms an X arrangement together with the latter.

[025] In the axial space between the conical-roller bearings 30, 32 the planetary carrier 8 has on the two sides of each planetary gear wheel 10 bores 34, 36 that extend through the carrier. These bores 34, 36 each accommodate a planetary bearing pin 38, on which the planetary gear wheel 10 is mounted by means of cylindrical rollers 40 and can rotate. The end surface of the planetary bearing pin 4038 abuts against the inner ring of the planetary carrier bearing 32, 34, so that it is advantageously secured against axial displacement without further measures. On each side of each planetary gear wheel 10 thrust washers in the form of annular discs are arranged on the planetary bearing pin 38, and these restrict the axial movement of the planetary gear 10.

[026] The bearing 28 for the sun gear shaft 4 is secured in the planetary carrier 8 against axial displacement in one direction by a circlip 46. To fit the bearing 28, the circlip 46 can be pressed completely into an annular groove 48 in the planetary carrier, which is axially adjacent to the functional surface 47 that receives the outer ring of the bearing. As soon as the outer ring of the bearing 28 has been pushed past the area of the annular groove 48 during assembly, the circlip 46 snaps together and so secures the outer ring of the bearing against axial displacement.

[001] PLANETARY GEAR FOR MOUNTING ON AN ELECTROMOTOR

[002]

[003] The invention relates to a planetary gear for mounting on an electromotor, according to the pre-characterising portion of the principal claim.

[004]

[005] Such planetary gears are used for many purposes in automation technology and plant and machinery in general. With such a planetary gear, in which a sun gear can be driven by an output shaft of the electromotor, an annular gear is positioned in the housing and a planetary carrier forms the output, various transmission ratios, typically in the range 4:1 to 10:1, can be produced by varying the geometry of the sun gear and planetary gear wheels and of the planetary carrier.

[006] Owing to the high power density involved, even small internal power losses can give rise to undesired high temperatures. Because of the compactness of the structure, the heat generated by these losses often cannot be dissipated to the desired extent. High temperatures affect service life adversely. A large part of the power loss is attributable to the seals and bearings of the rapidly rotating sun gear shaft on the input side.

[007] A gear of this type is disclosed for example in DE 198 08 184 C1. To receive an output shaft of the electromotor, the sun gear shaft of this known planetary gear is made hollow in a receiving area of enlarged diameter. The sun gear shaft is sealed with respect to the housing by a radial sealing ring.

[008]

[009] The purpose of the present invention is to develop further a planetary gear of the type described so as to minimise the power loss. Furthermore, the planetary gear should be of compact structure and economical to manufacture.

[010] The invention's objectives are achieved by a planetary gear of the said type incorporating also the features of the characterising portion of the principal claim.

[011] Thus, in accordance with the invention the sealing element that seals the sun gear shaft on the outside with respect to the housing is arranged axially

outside the receiving area for the output shaft of the electromotor in an axial section of the sun gear shaft with a reduced outer diameter compared with the receiving area. As a result of the smaller outer diameter, considerably less heat is generated by power loss between the rapidly rotating sun gear shaft and the sealing element. In addition, seal wear and seal leakage are reduced and the cost of the sealing element is lower.

[012] In an advantageous embodiment of the invention a bearing is provided for the sun gear shaft, whose inner ring is arranged axially outside the receiving area for the output shaft of the electromotor, on an axial section of the sun gear shaft with a reduced outer diameter compared to the receiving area. Compared with a bearing arranged in the receiving area of the sun gear shaft or directly adjacent thereto, such a bearing can be made of a size commensurate with the load occurring and does not need to be made oversize. The smaller size of the bearing results in less power loss and is both more economical and lighter. Naturally, instead of two separate components for the sealing element and the bearing, a bearing with an integrated sealing element can also be used.

[013] In a further advantageous embodiment of the invention the outer bearing ring of the sun gear shaft bearing is not positioned in the housing, but in the planetary carrier. Since the planetary carrier rotates in the same direction as the sun gear wheel, the relative rotation speed between the sun gear shaft and the planetary carrier is lower than the relative rotation speed between the sun gear shaft and the housing. This results in further reduction of the power loss, with further improvement in the gear efficiency.

[014] Advantages in relation to compact size can be achieved by arranging the bearing for the sun gear shaft radially inside an inner ring of a planetary carrier bearing and axially at least partly within the structural space occupied by the planetary carrier bearing.

[015]

[016] Other advantageous features of the invention are explained with reference to the attached drawing, which shows a longitudinal section through a planetary gear according to the invention.

[017]

[018]

[019] In the single figure attached, the housing is indexed as 2, the sun gear shaft on the input side as 4 and the output shaft of a planetary gear according to the invention as 6. The output shaft 6 rotates with a planetary carrier 8, on which several uniformly distributed planetary gear wheels 10 are mounted and able to rotate. The planetary gear wheels 10 are in simultaneous gear-tooth engagement with a central sun gear 12 that can be driven by the sun gear shaft 4 and with an annular gear 14 fixed in the housing 2.

[020]

To receive an output shaft (not shown) of an electromotor, the sun gear shaft 4 has a hollow receiving area 16 that extends axially over the length of a cylindrical bore 18 in the sun gear shaft 4. The inside space of the housing 2 is filled with lubricant and sealed with respect to the outside by two sealing elements formed as radial sealing rings 20, 22. The radial sealing rings are fixed in the housing 2 and are associated with cylindrical functional surfaces 24, 26 of the output shaft and the sun gear shaft respectively. Sliding friction takes place between the radial sealing rings and the said functional surfaces.

[021]

According to the invention, the radial sealing ring 22 arranged between the housing 2 and the sun gear shaft 4 is positioned outside the receiving area 16 for the output shaft of the electromotor in an axial section of the sun gear shaft whose outer diameter is smaller compared with that of the receiving area. Only very small frictional losses occur on the functional surface 26, whose diameter is smaller than the diameter of the bore 18, so that higher efficiency is attained and problems due to high temperatures are avoided. Between the receiving area 16 and the location of the radial sealing ring 22 the sun gear shaft has a diameter step 23.

[022] The inner ring of the bearing 28 for the sun gear shaft 4 is also arranged outside the receiving area 16 for the output shaft of the electromotor in an area with reduced outer diameter, so that a bearing of smaller size can be used.

[023] The diameter of the bearing holder on the sun gear shaft is also smaller than the diameter of the bore 18.

[024] The outer bearing ring of the bearing 28 is located in the planetary carrier 8, radially inside the inner ring of a planetary carrier bearing 30. The bearing 28 is positioned axially within the structural space occupied by the planetary carrier bearing 30, and this makes it possible for the axial length of the planetary gear to be short. For the planetary carrier 8 a second bearing 32 is provided which, like the bearing 30, is in the form of a conical-roller bearing and which forms an X arrangement together with the latter.

[025] In the axial space between the conical-roller bearings 30, 32 the planetary carrier 8 has on the two sides of each planetary gear wheel 10 bores 34, 36 that extend through the carrier. These bores 34, 36 each accommodate a planetary bearing pin 38, on which the planetary gear wheel 10 is mounted by means of cylindrical rollers 40 and can rotate. The end surface of the planetary bearing pin 40 abuts against the inner ring of the planetary carrier bearing 32, 34, so that it is advantageously secured against axial displacement without further measures. On each side of each planetary gear wheel 10 thrust washers in the form of annular discs are arranged on the planetary bearing pin 38, and these restrict the axial movement of the planetary gear 10.

[026] The bearing 28 for the sun gear shaft 4 is secured in the planetary carrier 8 against axial displacement in one direction by a circlip 46. To fit the bearing 28, the circlip 46 can be pressed completely into an annular groove 48 in the planetary carrier, which is axially adjacent to the functional surface 47 that receives the outer ring of the bearing. As soon as the outer ring of the bearing 28 has been pushed past the area of the annular groove 48 during assembly, the circlip 46 snaps together and so secures the outer ring of the bearing against axial displacement. The inner bearing ring of the bearing 28 is located axially on the sun gear shaft 4

in a position limited by a securing ring 50 and by a diameter step 52 in the sun gear shaft 4.

[027] Between the face of the outer bearing ring of the bearing 28 opposite the circlip 46 and an annular disc-shaped functional surface 54 of the planetary carrier 8 is positioned a rubber O-ring 56, which serves as an elastic compensating element. Thus, the sun gear shaft 4 can undergo slight axial displacement relative to the planetary carrier 8 and the housing 2 against the restoring force action of the O-ring 56. In this way length expansions of the sun gear shaft 4 and/or the output shaft of the electromotor resulting from temperature changes can be compensated. As an alternative, the sun gear shaft can be fitted so that it cannot move axially relative to the housing and a spring disc coupling, such as that shown in the document DE 199 51 613 not published earlier, can be positioned between the sun gear shaft 4 and the output shaft of the electromotor.

Index numbers

2	housing	30	bearing
4	sun gear shaft	32	bearing
6	output shaft	34	bore
8	planetary carrier	36	bore
10	planetary gear wheel	38	planetary bearing pin
12	sun gear	40	cylindrical rollers
14	annular gear	42	thrust washer
16	receiving area	44	thrust washer
18	bore	46	circlip
20	radial sealing ring	47	functional surface
22	radial sealing ring	48	annular group
23	diameter step	50	securing ring
24	functional surface	52	step
26	functional surface	54	functional surface
28	bearing	56	O-ring

Claims

1. Planetary gear for mounting on an electromotor with planetary gear wheels (10) fitted in a rotating planetary carrier (8) that forms the output and which are in simultaneous gear-tooth engagement with a sun gear (12) and an annular gear (14) positioned in a housing (2), such that the sun gear (12) is connected to a rotating sun gear shaft (4), which is made hollow in a receiving area (16) to receive an output shaft of the electromotor, a sealing element (22) being provided between the sun gear shaft (4) and the housing (2), characterized in that the sealing element (22) is located axially outside the receiving area (16) for the output shaft of the electromotor, in an axial section of the sun gear shaft (4) with a reduced outer diameter compared to the receiving area (16).

2. Planetary gear according to Claim 1, characterized in that there is at least one bearing (28) for the sun gear shaft (4), whose inner ring is located axially outside the receiving area (16) for the output shaft of the electromotor on an axial section of the sun gear shaft (4) with a reduced outer diameter compared to the receiving area (16).

3. Planetary gear according to Claim 2, characterized in that the outer bearing ring of the bearing (28) for the sun gear shaft (4) is positioned in the planetary carrier (8).

4. Planetary gear according to either of Claims 2 or 3, characterized in that the bearing (28) for the sun gear shaft (4) is located radially inside an inner ring of a planetary carrier bearing (30) and axially at least partly within the space occupied by the planetary carrier bearing (30).

5. Planetary gear according to any of the preceding claims, characterized in that the planetary carrier (8) has through-going bores (34, 36) on either side of each planetary gear wheel (10) to accommodate a planetary bearing pin (38) on which the planetary gear wheel (10) is mounted to rotate, and the planetary bearing pin (38) abuts with its end face against inner bearing rings of planetary carrier bearings (30, 32), so that the planetary bearing pin (38) is secured against axial displacement.

6. Planetary gear according to any of Claims 3 to 5, characterized in that an annular groove (48) is provided in the planetary carrier (8) to receive a circlip (46), which is axially adjacent to a functional surface (47) that receives the outer bearing ring of the bearing (28) for the sun gear shaft, and the outer bearing ring is secured against axial displacement in one direction by the circlip (46).

7. Planetary gear according to any of Claims 2 to 6, characterized in that the sun gear shaft (4) is mounted so that it can be axially displaced against the restoring force action of an elastic compensating element (56).

8. Planetary gear according to Claim 7, characterized in that the axial compensating element is positioned axially between a face of the outer bearing ring opposite the circlip (46) and a functional surface (54) of the planetary carrier (8).

9. Planetary gear according to Claim 8, characterized in that the elastic compensating element is an O-ring (56).

10. Planetary gear according to any of Claims 2 to 6, characterized in that the sun gear shaft (4) is fitted so that it cannot move axially relative to the housing (2) and a spring-disc coupling is arranged between the sun gear shaft (4) and the output shaft of the electromotor to compensate axial displacements.

11. Planetary gear according to any of the preceding claims, characterized in that the diameter of the functional surface (26) of the sun gear shaft (4) associated with the sealing element (22) is smaller than the diameter of the bore (18) in the receiving area (16) of the sun gear shaft (4).

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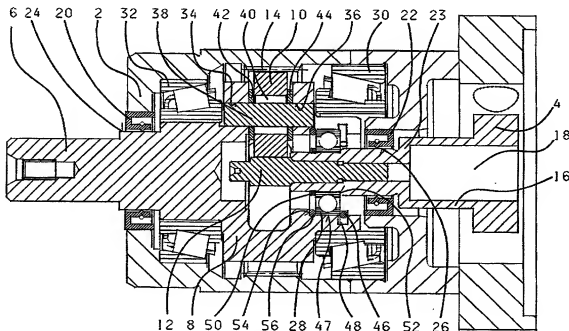
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Friedrichshafen (DE).

— Mit internationalem Recherchenbericht.
— Vor Ablauf der für Änderungen der Ansprüche geltenden
Frist; Veröffentlichung wird wiederholt, falls Änderungen
eintreffen.

[Fortsetzung auf der nächsten Seite]

(54) Title: PLANETARY GEAR FOR MOUNTING ON AN ELECTROMOTOR

(54) Bezeichnung: PLANETENGETRIEBE ZUM ANBAU AN EINEN ELEKTROMOTOR



(57) Abstract: The invention relates to a planetary gear for mounting on an electromotor. According to the invention, a high degree of efficiency is obtained by positioning a sealing element (22) that is located between the housing (2) and a sun gear shaft (4) on the input side, axially outside of a receiving area (16) for the driven shaft of the electromotor, in an axial section of the sun gear shaft (4), with a reduced outer diameter compared to the receiving area (16).

[Fortsetzung auf der nächsten Seite]

WO 01/38759 A1

10/089732

JC13 Rec'd PCT/PTO 03 APR 2002

04/3/02

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of : Tino KIRSCHNER
Serial no. :
For : PLANETARY GEAR FOR MOUNTING ON AN
ELECTROMOTOR
Docket : ZAHFRI P437US

BOX PCT

The Commissioner of Patents and Trademarks
Washington, D.C. 20231

SUBMISSION OF FORMAL DRAWINGS

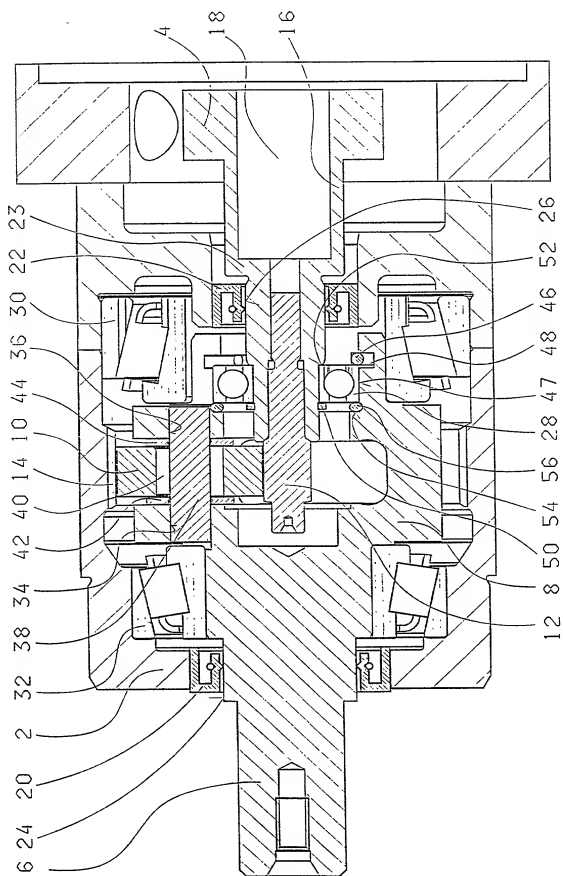
Enclosed please find one (1) sheet of formal drawings which are to be entered in this case.

In the event that there are any fee deficiencies or additional fees are payable, please charge the same or credit any overpayment to our Deposit Account (Account No. 04-0213).

Respectfully submitted,


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COMBINED DECLARATION AND POWER OF ATTORNEY
(Original, Design, National Stage of PCT, Supplemental)

As a below named inventor, I hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type: (check one applicable item below)

- original
design
supplemental
X National Stage of PCT
divisional (see added page)
continuation (see added page)
continuation-in-part (see added page)

INVENTORSHIP IDENTIFICATION

My residence, post office address and citizenship are as stated below next to my name. I believe that the original, first and sole inventor (*if only one name is listed below*) an original, first and joint inventors (*if plural names are listed below*) of the subject matter that is claimed, and for which a patent is sought on the invention entitled:

TITLE OF INVENTION

PLANETARY GEAR FOR MOUNTING ON AN ELECTROMOTOR

SPECIFICATION IDENTIFICATION

The specification of which: (complete (a), (b) or (c))

(a) is attached hereto.

(b) was filed on _____ as " Serial No.

0 / _____ or " Express Mail No. _____ (as Serial

No. not yet known) _____ and was amended on _____ (if applicable).

(c) **X** was described and claimed in PCT International

Application No. PCT/EP00/11582 filed on

21 November 2000 (21.11.2000) and as amended under PCT

Article 19 on _____ (if any).

POWER OF ATTORNEY

As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name(s) and registration number(s))

Anthony G. M. Davis Registration No. 27,868

Michael J. Bujold Registration No. 32,018

Scott A. Daniels Registration No. 42,462

Attached as part of this Declaration and Power of Attorney is the authorization of the above-named attorney(s) to accept and follow instructions from my representative(s).

Send Correspondence to
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ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent Office all information which is known to be material to patentability of this application as defined in § 1.56 of Title 37 of the Code of Federal Regulations.

PRIORITY CLAIM

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

EARLIEST FOREIGN APPLICATION(S), IF ANY FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

COUNTRY	APPLICATION NO.	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 37 USC 119
Fed. Rep. of Germany	199 56 789.1	(25.11.99) 25 November 1999	<input checked="" type="checkbox"/> YES NO
			YES NO
			YES NO
			YES NO
			YES NO

ALL FOREIGN APPLICATION(S), IF ANY FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signature(s)

1-00
Full name of sole ~~inventor~~ ^{applicant} **Tino KIRSCHNER**

Inventor's signature Tino Kirschner Date 2002-03-12

Country of Citizenship **Fed. Rep. of Germany**

Residence **Mariabrunnstr. 59, D-88097 Eriskirch, Germany** **DEX**

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